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NOTE ON THE ANATOMY AND PATHOLOGY  
OF THE SKIN.

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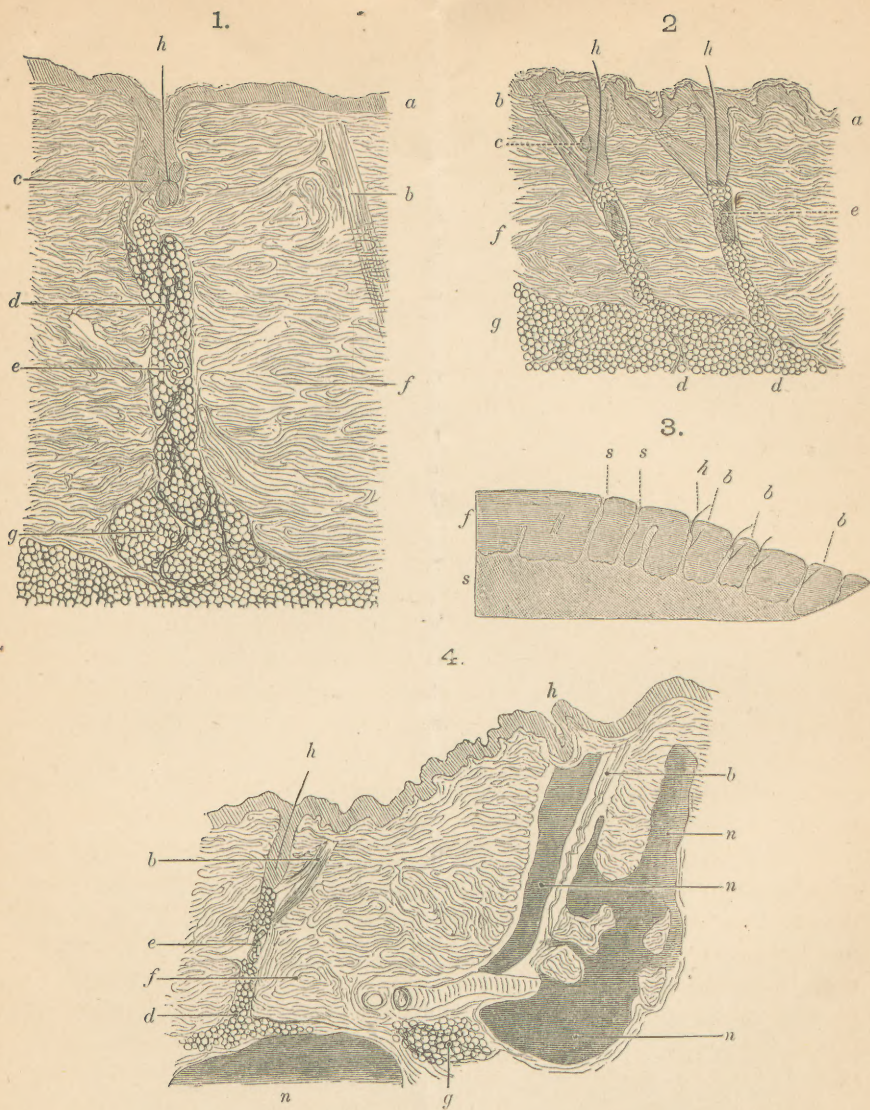
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#### EXPLANATION OF FIGURES.

*Figure 1.* Section of skin from back of an adult, showing fat canal and lanugo hair, magnified 10 diameters.

" 2. Section of skin from the shoulder of an infant, magnified 17 diameters.

" 3. Fragment of skin adherent to a round-cell sarcoma of the subcutaneous connective tissue of the back, natural size.

" 4. Section of the skin of an infant invaded by a rapidly spreading naevus, magnified 17 diameters.

*a.* Epidermis.

*b.* Erector pili muscle.

*c.* Sebaceous gland.

*d.* Fat canal.

*e.* Sudoriparous gland.

*f.* Cutis vera.

*g.* Adipose tissue.

*h.* Hair.

*n.* Naevus.

*s.* Sarcoma.

## NOTE ON THE ANATOMY AND PATHOLOGY OF THE SKIN.<sup>1</sup>

BY J. COLLINS WARREN, M. D.

IN the report of the proceedings of the society for April 27, 1875, published in the *New York Medical Journal* for that year, a description is given of a specimen of round-cell sarcoma, which, arising in the tissue beneath the skin of the back, had at the time of its removal begun to infiltrate the superjacent cutis. A vertical section through the skin and tumor disclosed the interesting feature of this specimen. The cutis, which was quite thick, showed beneath it the outline of the disease sharply defined, whence projecting upward to the surface were several slender, parallel columns of sarcoma tissue at equal distances from one another, reaching the epidermis at points where the little dimples made by the openings of the hair follicles were to be seen (Figure 3). The following is the report of the microscopical examination made at the time for the purpose of throwing light upon this unusual phenomenon: "Topographical sections of the part made by Dr. Quincy showed that in forming these columns the disease had followed the hair follicles and sweat ducts. The sweat ducts could not be traced to the surface in these prolongations in all cases, but the hair follicles were almost invariably found. More minute examination of the intervening cutis showed the connective tissue fibres at many points to be indiscriminately mingled with small, round cells." Horizontal sections showed these columns to be cylindrical in shape, and not slits or clefts in the cutis occupied by the disease. At varying distances from the surface the masses of cells branched off horizontally, infiltrating the skin in different directions. This was readily seen both in horizontal and vertical sections.

At a meeting of the society held September 28, 1875, a description of the adjacent healthy skin was given,<sup>2</sup> the structure of which readily explained the peculiar disposition of the infiltrating cells. It was apparent to the naked eye that the subjacent adipose tissue penetrated the cutis vera for some distance, forming vertical parallel columns reaching nearly to the surface. Sections of this skin showed under the microscope the appearances represented in Figure 1. From the adipose layer there arises at a slight angle from the perpendicular a long, slender column of adipose tissue (*d*), terminating directly beneath the root of a lanugo hair (*h*), which, as will be seen, penetrates but a short distance the thick layer of

<sup>1</sup> Communicated to the Boston Society of the Medical Sciences.

<sup>2</sup> Report of the Proceedings of the Boston Society of Medical Sciences from September, 1875, to May, 1876. Reprinted from the *New York Medical Journal*.



cutis. At about the centre of this canal — for the cylindrical-shaped cavity of the cutis which contains this column of fat is thus most appropriately named — the coil of a sudoriparous gland (*e*) may be seen. This gland is much more distinct in the section than in the drawing. In some instances the duct may also be seen extending to the apex of the canal, whence it may be traced to the side of the hair follicle, where it probably finds its way to the surface. (In dogs the sweat duct opens into the hair follicle itself at a short distance from its mouth.) The sudoriparous gland is suspended, as it were, in the soft adipose tissue by delicate bands of connective tissue which traverse the canal in a longitudinal direction. These bands of fibres were found in other sections to accompany a blood-vessel running in a very straight course from the adipose layer below to the base of the sweat gland, beyond which occasionally it might be traced. Around the base of the hair follicle is the sebaceous gland (*e*), from the open mouth of which the hair seems almost to spring. A short distance above the level of the sweat gland are two clefts in the cutis extending obliquely upwards from the canal. These clefts are quite constant (Figures 1 and 2), and may be found to contain a blood-vessel or a fragment of a sweat gland. It was evidently through these channels that the sarcoma cells spread in a horizontal direction. There were a few longer hairs, which passed through the entire thickness of the cutis, and in the neighborhood of these no such structures as we have described were found. The diseased tissue as it began to involve the skin advanced through natural channels, which from their anatomical character would offer less resistance to elements penetrating from the subcutaneous tissue to the surface than the dense fibrous portions of the cutis vera.

Skin from various parts of the body and from individuals of various ages was examined to determine how constant a structure this was. A section of the skin of an infant, taken from the shoulder (Figure 2) shows well the relation of these fat canals to the hair follicles and erector pili muscles. We see, as before, the sweat glands which, we may say here, are always to be found in these canals, although they are also seen in the intervening structure of the cutis. The obliquity of the canal places it at a slight angle to the shaft of the hair, while its long axis is nearly parallel and continuous with that of the erector pili muscle, the lower border of which is as a general thing directly continuous with the adjacent border of the canal. The sebaceous gland (*e*) is seen between the muscle and hair follicle, the position usually ascribed to it. It will be observed that the hair curves to the side on which the muscle is situated. This I have found to be constant and in accordance with the description of other writers. (Figures 2, 3, and 4.) Skin was examined from the back, chiefly near the median line, the shoulder, arm, breast, abdomen, and lower extremities. In all these specimens fat



canals were found to exist and to bear the relation to the lanugo or downy hair which has been described. The length of these canals varied, of course, with the thickness of the skin. On the back, between the shoulders, they were most typically developed, and in individuals who were fat the breadth of the canal exceeded frequently that shown in Figure 1. The actual thickness of skin in Figure 1 at its narrowest part is 5.5 mm. The length of the fat canal is 4 mm. On the other hand, in lean individuals, where the tissue beneath the cutis was devoid of fat, no fat cells were found in the canals. A delicate connective-tissue network is there seen supporting blood-vessel and sweat gland. In thin skin the canals are either short or, if the hair is of sufficient length to extend to the bottom of the cutis, absent. A thick skin and the existence of downy hairs are, then, the conditions necessary for the presence of this structure in its most marked form. The frequency with which these canals occur depends upon the quantity of hair. In some sections of half an inch in length I have seen as many as five. In Figure 3 the canals are numerous, but no more so than is often found on the back, where they seem to exist in the greatest numbers. At other points long intervals occur where none are found. I did not find these canals in the skin of the face of a female, the cutis vera being thinner and less dense than in other specimens examined. In the lip of a rat, although the tissue in which the long hairs were embedded was quite transparent, vertical rows of fat cells, arranged like the beads of a rosary, were seen beneath the roots of many of the hairs.

It having been suggested that this was the route of the lymphatic vessels, a reference to Neumann's work on the lymphatics of the skin<sup>1</sup> showed that no such structure was alluded to. This author describes the lymphatic vessels as distributed through the skin in two horizontal layers, a superficial and a deep one, the vertical connection between the two being found only at comparatively rare intervals. The following experiments were made to determine the question of the presence of lymphatic vessels in these canals, and also to observe to what extent fluids and particles pressed up from below could be forced to the surface : —

Skin was taken from the body of an individual within twenty-four hours after death. A small amount of the loose areolar tissue was left adherent to its lower surface. The skin being prepared by warming for a few minutes in water of about 90° F., Berlin blue was injected by means of a subcutaneous syringe into the loose areolar tissue, which was rapidly distended by the fluid. The specimen was then thrown into strong alcohol. A similar fragment of skin was stretched like a drum over the end of a brass cylinder, to which it was firmly attached by an open brass cap and screws. The cylinder being held vertically, Berlin blue

<sup>1</sup> Zur Kenntniss der Lymphgefäße der Haut. Von Isidor Neumann.



was poured upon the skin, the outer surface of which looked downwards; a rubber cork perforated by a glass tube was securely fastened to the top of the cylinder, and the tube was connected with an apparatus designed to exert any atmospheric pressure required. The pressure, sufficient to raise a column of mercury twenty-eight millimeters, was continued for an hour and a half, the skin being pressed out in dome-shape, at the bottom of the cylinder, with great force. The specimen was then placed in alcohol. It was observed that the injection mass had gone at one or two points to the surface, and on making vertical sections of the skin the next day the cutis was found to be penetrated by the mass in vertical blue lines, which united at various points by horizontal branches, occasionally so numerous as to present an almost continuous blue surface. The subcutaneous areolar tissue was uniformly colored blue. The first specimen showed on section the same vertical lines at one or two points, but the force of the injection had not been sufficient to carry the blue mass into all the canals. Thin sections placed under the microscope showed that the mass had passed into the canals already described. As the subject was lean and the fat absent, the route of the fluid could be studied with facility. The injection mass could be seen on entering the canal to follow the course of a blood-vessel (already described), at first surrounding and obscuring it, but as it failed in quantity to lie in patches on its surface. At no point could an injection of the vessel itself be discovered. It is probable, therefore, that the channels injected by this mass were lymphatic ("perivascular lymph spaces"), and that the two horizontal layers of lymphatics described by Neumann are brought into communication by these routes.

The special function of these canals is not evident. In addition to furnishing a route for the blood-vessels and lymphatics, there would seem to be some connection with the hair and its apparatus. The constant relation which they bear to this structure and the erector pili muscle would suggest a condition designed to facilitate the action of the muscle. According to Biesiadecki,<sup>1</sup> this muscle by its contraction raises the hair from the position which it occupies nearly horizontal to the surface to a more vertical one. That this must be the result of a contraction of this muscle is evident from a glance at Figures 2, 3, and 4. Any movement of the root of a lanugo hair would be well-nigh impossible, imbedded in the dense tissue of the cutis, were it not for a yielding structure like that of the canal, an elongation of which would greatly aid the contraction of the muscle. The presence of fat near the hair bulb is made possible by this structure, which may therefore have some bearing upon the nutrition of the hair.

The possibility of diseased products finding their way from below to the surface through these canals induced me to seek for other examples beside that already referred to.

<sup>1</sup> Stricker's Handbuch der Lehre von den Geweben des Menschen und der Thiere.



Nævi, which are congenital and appear and spread on the surface of the skin soon after birth, are developed in the subcutaneous adipose tissue chiefly, which will always be found to be more extensively affected than the skin above. A rapidly spreading nævus on the shoulder of an infant was excised by Dr. George H. Gay, who kindly gave me the specimen to examine. A vertical section through the specimen showed the lobulated vascular tissue occupying the place of the adipose layer. At the point where the invasion of the skin began (Figure 4), elongated masses of the disease could be observed even with the naked eye, and easily with a lens, to extend nearly to the surface. These prolongations were vertical and parallel, and a higher power showed that they communicated freely with one another (*n*) by horizontal coils of the vascular tissue until the development of the disease reached a point where the cutis vera was no longer to be found. This method of invasion is shown in Figure 4, the cutis vera appearing where the disease is present as islets in the vascular tissue. The erector pili muscle (*b*) of one of the canals invaded is still seen, but has been unusually elongated, the development of the disease having raised the surface of the skin at this point above its natural level. The lobulated character of the vascular tissue peculiar to nævi is shown at the bottom of the drawing. The magnifying power is of course too low to show the vessels well, and no attempt has been made to draw them. Perhaps the most striking instance which can be offered of disease working to the surface is seen in carbuncle. In this affection the pus infiltrates the parts attacked, and does not collect within a circumscribed wall, as in abscess. Its situation on the back, where the canals are found to be larger than elsewhere, and its peculiar honey-combed character, suggested an invasion of the skin through these canals. An examination of the piece of skin removed from the border of a carbuncle confirmed this belief. The fat canals were found distended with small, round cells, which distended also the horizontal clefts of the cutis communicating with these canals. As the centre of the disease was approached, the cutis intervening between two of these canals was found much softened, and crumbled under the razor. The small, circular openings formed in the skin by the pus, an appearance so characteristic of carbuncle, were bounded by several columns of pus or wandering cells occupying the place of the now broken-down tissues of the canals, while the intervening cutis, occupying probably the district supplied with nutriment through these channels, had melted away. Vertical sections of skin still in a tolerable state of preservation presented the appearance described already in the case of the round-cell sarcoma (Figure 3). Owing to their distention with pus or cheesy products the vertical columns are easily recognized.

Whether the so-called "core" of a boil may not be the necrosed fragment of cutis cut off from its blood supply by the obliteration of



one or more of these canals by inflammatory products, I have had no opportunity yet to determine. Whether the situation of vesicles or papules in a cutaneous eruption corresponds in any way to the distribution of these canals is also a subject for future inquiry.

In a case of melanotic sarcoma of the skin of the back, situated just beneath the corium, a number of sections were made to observe the progress of the disease downwards through the skin. Although the canals were numerous, the disease had hardly reached a sufficient depth to determine to what extent its further progress might have been modified by these structures. In those directly beneath the tumor a small, round-cell infiltration was observed in one or two instances. The more malignant form of cancer of the skin, of which cancer of the lip is the type, might be found to traverse these canals. In the lip and penis, however, the canals would not be found. When occurring on other parts of the skin, on the back of the hand, as it occasionally does, it might be studied to advantage.

In drawings of vertical sections of the skin, irregularities of contour are sometimes to be seen at the line of junction of the adipose layer with the cutis vera, or irregularities in the arrangement of the fibres of the cutis, indicating that the section has been made near a canal. I have been unable, however, to find any description of these fat canals in modern text-books or recent periodical literature.

The drawings were made by Dr. H. P. Quincy from sections prepared by him. The experiments were performed in Professor Bowditch's laboratory.







